Submitted by the expert from IEA

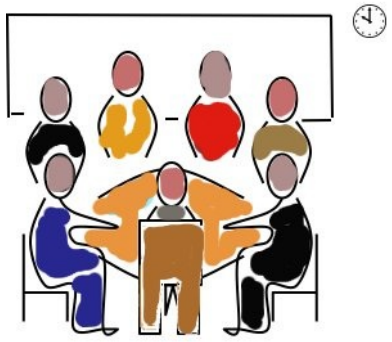
Informal document **GRVA-09-21**
9th GRVA, 1-5 February 2021
Provisional agenda item 3

Human Factors Challenges of Remote Support and Control

Oliver Carsten

HF-IRADS

New group



- **HF-IRADS**

  "Human Factors in International Regulations for Automated Driving Systems"

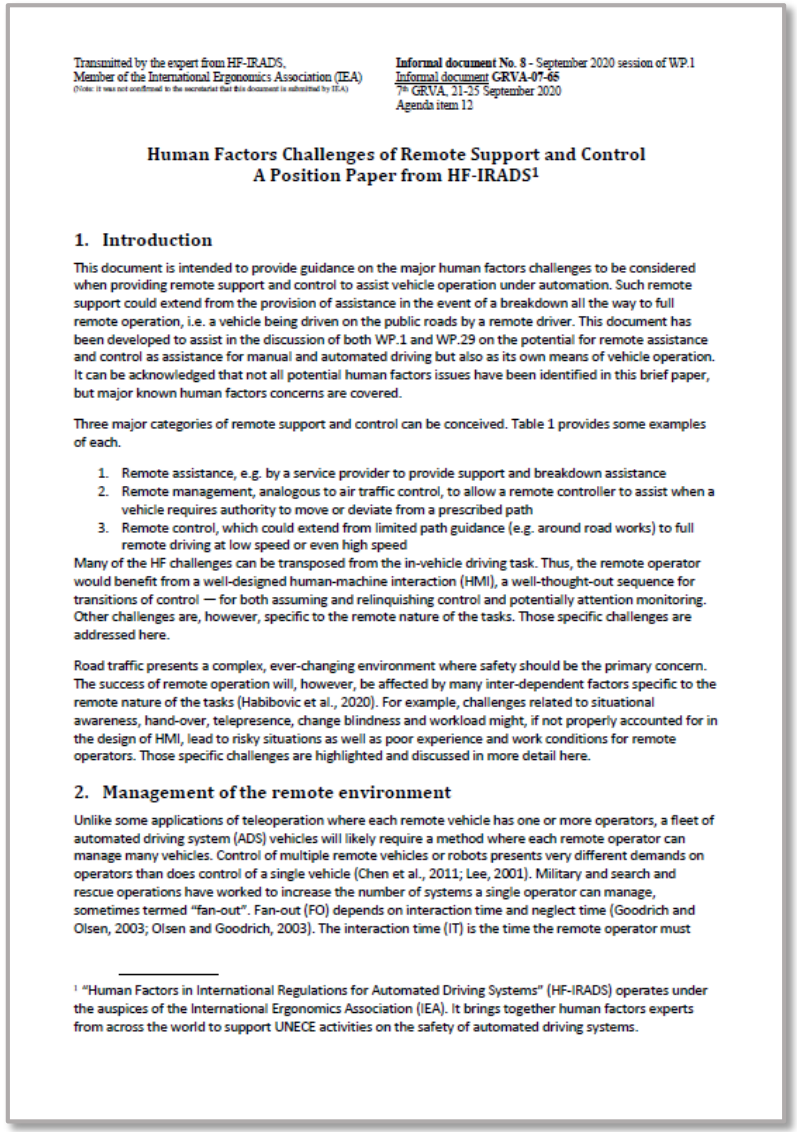
- Operates under the auspices of the International Ergonomics Association (IEA), which has consultative status as an NGO with ECOSOC
- Brings together human factors experts from across the world to support UNECE activities on the safety of automated driving systems
- Members from North America, Europe, Japan and Australia
- All volunteering their time

Aim

- To provide expert human factors support to the UNECE in the areas of vehicle regulations and road safety

- The group has members who already participate in the meetings of WP.1, IGEAD, FRAV and VMAD

Informal document GRVA-07-65
7th GRVA, Agenda Item 12



Transmitted by the expert from HF-IRADS,
Member of the International Ergonomics Association (IEA)
(Note: it was not confirmed to the secretariat that this document is submitted by IEA)

Informal document No. 8 - September 2020 session of WP.1
Informal document **GRVA-07-65**
7th GRVA, 21-25 September 2020
Agenda item 12

Human Factors Challenges of Remote Support and Control
A Position Paper from HF-IRADS[1]

1. Introduction

This document is intended to provide guidance on the major human factors challenges to be considered when providing remote support and control to assist vehicle operation under automation. Such remote support could extend from the provision of assistance in the event of a breakdown all the way to full remote operation, i.e. a vehicle being driven on the public roads by a remote driver. This document has been developed to assist in the discussion of both WP.1 and WP.29 on the potential for remote assistance and control as assistance for manual and automated driving but also as its own means of vehicle operation. It can be acknowledged that not all potential human factors issues have been identified in this brief paper, but major known human factors concerns are covered.

Three major categories of remote support and control can be conceived. Table 1 provides some examples of each.

1. Remote assistance, e.g. by a service provider to provide support and breakdown assistance
2. Remote management, analogous to air traffic control, to allow a remote controller to assist when a vehicle requires authority to move or deviate from a prescribed path
3. Remote control, which could extend from limited path guidance (e.g. around road works) to full remote driving at low speed or even high speed

Many of the HF challenges can be transposed from the in-vehicle driving task. Thus, the remote operator would benefit from a well-designed human-machine interaction (HMI), a well-thought-out sequence for transitions of control — for both assuming and relinquishing control and potentially attention monitoring. Other challenges are, however, specific to the remote nature of the tasks. Those specific challenges are addressed here.

Road traffic presents a complex, ever-changing environment where safety should be the primary concern. The success of remote operation will, however, be affected by many inter-dependent factors specific to the remote nature of the tasks (Habibovic et al., 2020). For example, challenges related to situational awareness, hand-over, telepresence, change blindness and workload might, if not properly accounted for in the design of HMI, lead to risky situations as well as poor experience and work conditions for remote operators. Those specific challenges are highlighted and discussed in more detail here.

2. Management of the remote environment

Unlike some applications of teleoperation where each remote vehicle has one or more operators, a fleet of automated driving system (ADS) vehicles will likely require a method where each remote operator can manage many vehicles. Control of multiple remote vehicles or robots presents very different demands on operators than does control of a single vehicle (Chen et al., 2011; Lee, 2001). Military and search and rescue operations have worked to increase the number of systems a single operator can manage, sometimes termed "fan-out". Fan-out (FO) depends on interaction time and neglect time (Goodrich and Olsen, 2003; Olsen and Goodrich, 2003). The interaction time (IT) is the time the remote operator must

[1] "Human Factors in International Regulations for Automated Driving Systems" (HF-IRADS) operates under the auspices of the International Ergonomics Association (IEA). It brings together human factors experts from across the world to support UNECE activities on the safety of automated driving systems.

Covers:

- Categories of remote support and control
- Management of the remote environment
- Training and personnel
- Controls and displays
- Communication channels
- Needs of passengers in the vehicle
- Service design, including definition of the ODD for a service

Categories of remote support and control

We distinguish:

1. ***Remote assistance***, e.g. by a service provider to provide support and breakdown assistance
2. ***Remote management***, analogous to air traffic control, to allow a remote controller to assist when a vehicle requires authority to move or deviate from a prescribed path
3. ***Remote control***, which could extend from limited path guidance (e.g. around road works) to full remote driving at low speed or even high speed

Conclusions

- Remote control and operation is complex. It should not be assumed that remote handling constitutes a viable backup for problems encountered by vehicles under the control of an ADS
- Thorough investigation of different use cases is needed. A safety case should be prepared for each specific application of remote support and control. Currently, there is a lack of evidence that remote vehicle operation on public roads can be performed safely.
- The proper design of the work environment for remote control and operation is vital.

Implications for UNECE WP.1 and WP.29

- WP.1
  - The WP.1 *Resolution on the Deployment of Highly and Fully Automated Vehicles in Road Traffic* states that an Automated Driving System "refers to a vehicle system that uses both hardware and software to exercise dynamic control of a vehicle on a sustained basis."
  - No mention is made of any possible assistance from or fallback to a remote centre. In any new version of this text, there should be consideration of the possibility of remote support, and thus the definition of an Automated Driving System may need to be expanded so as to encompass any required remote support.
- WP.29
  - The WP.29 *Revised Framework document on automated/autonomous vehicles* states that "an automated/autonomous vehicle shall not cause any non-tolerable risk". A definition of an "automated/autonomous vehicle" is not provided, but there is no mention of remote support as means of assistance, and remote support is not listed in the priority items.
  - It is therefore suggested that a whole system approach be adopted in GRVA and its sub-groups and that remote support be added to the list of priority issues to be addressed.

Thank you for your attention!